

signal. To combat the echo, an echo cancellation signal generator 11 correlates the microphone 4 signal with the ear speaker 3 signal to find the echo signal, and generates an inversion of the echo which is added into the microphone signal going to the transmitter (TXo).

Generating the Inversion. The strength of the inverted transmit signal is estimated by the echo delay (based on the assumption that the ear speaker has constant loudness and therefore the amplitude of the echo at the microphone is proportional to the distance, which in turn is directly proportional to the echo delay), and other coefficients are adjusted for other acoustic paths and characteristics. When the coefficients converge to the proper values, the echo is gone. However, it takes time for the coefficients to converge (specification page 3, line 12). The applied reference, Lane, mentions this fact at col. 1, lines 53-56.

A Problem. “A problem arising in [prior-art] FIG. 9,” writes the Applicant (bottom of page 3), “is that the varying gain [of the microphone signal] interferes with the accurate operation of the echo canceler 1.” Because the coefficients are functions of the microphone gain, they must be readjusted every time the gain changes. Echo reappears, for example, if the microphone has moved when the user again begins to speak (page 3, first full paragraph). Meanwhile, the transmit gain is continually adjusted, regardless of echo, whenever the microphone signal is above a threshold (page 3, second full paragraph).

The transmit gain and the microphone gain, which are the two inputs to the echo cancellation generator 11 in Fig. 9, are uncorrelated and both change abruptly, throwing the echo cancellation off and requiring the calculation of new coefficients.

The Solution. The Applicant, unlike the prior art, uses two AGC units instead of one, and adjusts the coefficients only when the user is *not* speaking.

According to claim 13, the echo cancellation signal generator updates the filter coefficients when the transmit signal is less than a first minimum input level and the receive signal exceeds a second minimum input level. Let this be called condition L (a “listening”

condition). Claim 13 recites that condition L is determined by comparing the transmit and receive signals TX_i and RX_i with a pair of respective thresholds.

The signal level data generator of claim 13 updates the signal level data when the transmit signal exceeds the first minimum input level and the receive signal is less than the second minimum input level. Let this be called condition M. The first and second AGC units update the first and second gains under condition M.

The Examiner is invited to note that while condition M is determined from the same pair of thresholds as is condition L, the conditions L and M are mutually exclusive and therefore the filter coefficients and the signal level data are never updated at the same time.

Accordingly, the filter coefficients and the gains of the AGC units are never updated at the same time. The specification at the bottom of page 11 points out that, because of this fact, gain variations do not interfere with the convergence of filter coefficients, and therefore convergence delays are avoided. This advances the art.

Another effect is that the gain is not adjusted while strong echo is present, so variations in the strong echo do not affect the AGC, and the outgoing voice signal is held at the desired, constant level. This also advances the art. The Examiner is referred to the top of page 12 in the specification.

Claims 13-15 were rejected over Horna, Lane, and Li.

Horna. Horna shows an AGC but does not teach any conditions for halting gain adjustment.

Lane. Lane shows a pair of AGC units in Fig. 3 and discloses suspending AGC control in a "listen" state. However, Lane's listen state is not the same as the Applicant's L condition discussed above, and does not anticipate the Applicant's claims. Lane's listen state is defined by a *ratio* E_T/E_R of the transmit and receive levels, as a glance at the lower axis of Lane's Fig. 5 will

show, and this ratio is the entire basis of the Lane method. The listen state is not defined by comparing each of E_T and E_R with a pair of respective threshold values (magnitudes).

An Error in the Rejection. The Examiner asserts at the bottom of page 8 that Fig. 4 of Lane shows comparison to thresholds. The Applicant respectfully answers that every line in Fig. 4 represents a particular ratio E_T/E_R (all lines are of the form $y = mx$ where m is slope, so m is a ratio of the values on the ordinate and abscissa) and therefore Fig. 4 discloses comparing one dimensionless ratio to another dimensionless ratio, rather than comparing either E_T or E_R to any threshold of signal magnitude. The lines T_T and T_R , which are mentioned by the Examiner, are ratio thresholds and not magnitude thresholds. In claim 13, “level” by its ordinary meaning refers to a signal magnitude measured in, e.g., voltage, rather than a dimensionless ratio.

In Lane's Fig. 4, particular magnitudes of E_T and E_R would be represented by horizontal or vertical lines, respectively; the only such lines that actually appear are the axes, which represent respectively $E_T = 0$ and $E_R = 0$. The axes are there merely to define the dashed and solid lines in between, and do not represent Lane's data.

Li. Li also uses a ratio, rather than comparison to a pair of thresholds. Li is based on Lane¹ and only presents a variation on what Lane presents.

Where Lane discloses its talk, double-talk, and listen regions, Li discloses a fourth region, “silence” (compare Figs. 2 and 4 of Li). Li states that the silence region “represents the presence of low signal energy on both the transmit signal and the receive signal” (col 6, line 13). However, the Applicant believes that Li's thresholds are not magnitude thresholds, but instead are ratio thresholds. Li states: “Silence is detected when the *ratio* of $B(n)/w(n)$ falls below a threshold value labeled ' $c(n)$ '.” (col. 6, line 40; emphasis added).

¹ Figs. 1-2 of Lane, labeled “prior art,” are copies of Lane's Figs. 1-2, and about ten paragraphs of Lane's text is copied in Li. Lane is cross-referenced by Li at col. 1, line 15, and John Lane, of the Lane patent, is the co-inventor of the Li patent. Both John Lane and Zhao Li work for Motorola and live in Austin.

Even if the silence zone were determined by magnitudes rather than ratios (not admitted), this would correspond to the case (c) + (d) in the Applicant's Fig. 4, and not to what is claimed or to the conditions L or M discussed above.

Li calls the transmit signal magnitude “x” and the receive value magnitude “y” (col. 7, lines 31-34). The ratio is determined on the basis of a comparison of the values of the transmit signal “x” and the receive value “y” to one another (steps 268 and 274 in Fig. 7). The Li “listen” state is detected by setting listen flag to “1” (step 262 in Fig. 7) or clearing the flag to “0.” Li also uses a pair of counting variables “k” and “n”.

Thus, claim 13 distinguishes over the applied art by comparing the transmit and receive signals to a pair of thresholds, instead of to each other. This enables the transmit signal threshold to be set to a minimum value for valid automatic gain control, while the receive signal threshold is set at a minimum value adequate for valid updating of the adaptive filter coefficients, as pointed out in the specification on page 8, lines 19-21.

Claim 14 contains more features than claim 13 and is patentable for the reasons above. Claim 15 depends from claim 14.

Claims 9-12 were rejected over Horna and Lane.

Claim 9. Claim 9 distinguishes in that the condition for updating the gain factors, namely transmit signal active *and* receive signal inactive, is not exactly the same as the condition for AGC control taught by Lane. Lane discloses AGC control in any state other than the “listen” state; this is equivalent to updating the gain when transmit signal *or* the receive signal is inactive. More basically, Lane teaches selection of one of three AGC modes—variable gain G, no gain, or function $f(G)$ —that operate continuously. That is, even when the “no gain” mode is selected, updating of the variable gain may continue, even though the variable gain is not used. Claim 9, in contrast, recites an automatic gain control scheme with only one mode, but holds the amplification factor of this mode constant when the receive signal is active.

Clarification is Requested. The Applicant earlier argued, "Lane applies a transmitting gain G (col. 4, line 64) and 'When in DOUBLE-TALK mode, AGC block 53 *adapts* the gain by performing a function $f(G)$ ' (col. 5, line 36; emphasis added). That is, the gain is changed." The Examiner has answered by stating that "the value G remains unchanged. As G has been mapped to the signal level data, it is clear that Lane does teach clause (c) of claim 9."

The Examiner's statement is not understood. Clarification is requested, and the Applicant requests a citation to the reference where a description of G being mapped to the signal data is disclosed.

Claims 10-12. These claims are patentable by their dependence.

Reconsideration, on the basis of the arguments above, is requested.

Respectfully submitted,



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